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ABSTRACT

A research project sought to develop and demonstrate the use of a spelling program taught to sixth graders by computer-assisted instruction (CAI). Students from three schools were divided into low-, medium-, and high-ability spellers; the individuals at each level were then assigned to either an experimental or a control group. The former used the CAI program SPELL, relying upon an IBM 1410 system and the COURSEWRITER I language; the latter received conventional instruction. Posttesting after 15 weeks indicated no significant overall differences between the two treatments; significant gains for low-ability students from one school were noted, irrespective of treatment, and for low- and medium-ability students in the CAI group in a second school. It was also learned that the pupils accepted CAI despite some hardward problems, that is was possible to discern the mode by which individual students learned best, and that school personnel could be trained to use CAI. It was concluded that CAI could individualize spelling instruction, and it was recommended that additional research study the use of CAI methods, particularly with low-ability students. (PB)

Center for
Cooperative Research With Schools

ED 039790

USE OF COMPUTER ASSISTED INSTRUCTION TO TEACH SPELLING TO SIXTH GRADERS

Co-Directors

George N. Demshock C. Alan Riedesel

Grant No. OEG-3-7-703518-4968

Project No. 70-3518

Final Report August 31, 1968

COLLEGE OF EDUCATION
THE PENNSYLVANIA
STATE UNIVERSITY
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Note to accompany the Penn State Documents.

In order to have the entire collection of reports generated by the Computer Assisted Instruction Lab. at Penn State University included in the ERIC archives, the ERIC Clearinghouse on Educational Media and Technology was asked by Penn State to input the material. We are therefore including some documents which may be several years old. Also, so that our bibliographic information will conform with Penn State's, we have occasionally changed the title somewhat, or added information that may not be on the title page. Two of the documents in the CARE (Computer Assisted Remedial Education) collection were transferred to ERIC/EC to abstract. They are Report Number R-36 and Report Number R-50.

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August 31, 1968

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USE OF COMPUTER ASSISTED INSTRUCTION TO TEACH SPELLING TO SIXTH GRADERS

I. Discuss the effect of the project on the clientele by briefly stating the major objectives of the project and the techniques used in evaluating the extent to which these objectives were achieved.

A. Introduction

The primary purposes of the project were to develop and demonstrate the use of a spelling program taught to sixth graders via computer-assisted instruction (CAI). It was originally the intention to develop two programs which would vary in their approach to spelling. Because the budget for the project was reduced by one-third, however, only one CAI spelling program was developed, incorporating several techniques. This program was tested for feasibility in comparison with the use of conventional classroom instruction techniques.

1. Rationale

Although the amount of research on spelling appears to be impressive, a careful analysis shows that the great majority of the significant data are concerned with the development of basic word lists. Other data indicate that there appears to be no relationship between intelligence and spelling competency. There are few guidelines for methodology; there is conflicting evidence on the merits of various approaches. (For specifics, see the review of related literature and the references in Appendix A.) CAI offers a means of ascertaining more about the teaching

of spelling because of the ability to control the previously uncontrolled teacher variable.

Emphasis in education has been and continues to be placed on the need to individualize instruction, and CAI offers great potential for doing this. Provision for several alternate branches at many places throughout the computer program can be made, in addition to specific help as any learner needs it.

2. Equipment

A CAI system includes several key pieces of equipment, central among which is the digital computer with its relatively high-speed information retrevial and operating capability. The computer used in this project, on a time-sharing basis, was the IBM 1410, located in the Computation Center of The Pennsylvania State University. Connected to it by dedicated telephone lines were four IBM 1050 student terminals, each consisting of a modified electric typewriter, a random-access tape recorder, and a random-access slide projector, all under computer control. The authors[1] stored the instructional program in the computer's memory using IBM's instructional language, COURSEWRITER I.

The computer types information and questions, or presents them via a tape recorder and/or slide projector, and the student replies by typing his responses. The computer programming allows for a variety of learning sequences which are based on the responses made by the individual

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[1] Mrs. Charlotte Farris and Dr. Marilyn N. Suydam, of the Center for Cooperative Research with Schools at The Pennsylvania State University authored the program.

student. Thus the learning sequence can be controlled by the computer to meet individual variations. Accuracy of responses is judged by the program, help can be provided at the moment it is needed, and knowledge of results follows immediately. Continual testing can be incorporated in the program, so that the student studies only those words which are not already a part of his spelling vocabulary. Through the use of branching techniques, remedial help can be provided to whatever depth it may be required.

3. Planning

The initial planning for this project began in October, 1966. Representatives of the State College Area School District and The Pennsylvania State University met and discussed the possibilities of exploring the use of computer-assisted instruction with children in the elementary school. The area of spelling seemed to be one which would lend itself to effective teaching by this means. There was found to be a previously existing program but it allowed for little individualization of instruction. The development of a program which utilized branching and which, moreover, would test particular approaches to spelling, seemed to be highly important and innovative. During the months of November and December, 1966, and January, 1967 further meetings were held to plan the project. These meetings included representatives from non-public schools, from Area J for Title III, and from the Pennsylvania Department of Public Instruction.

After the project was funded, additional meetings were held. Details involved in the planning and implementation of the project and the use

of equipment were discussed. Two of the District's elementary schools were selected to take part in the project, as well as the non-public school. The two District schools followed differing organizational patterns, with one (Radio Park) using a departmentalized plan and the other (Park Forest) having self-contained classrooms. Partially because of this evident school difference and partially because of research design factors, it was decided to use a replications design in setting up the experiment and in analyzing the data.

Planning conferences were held in September with the school principals and sixth grade teachers involved in the project. The purpose of these meetings was to (1) to provide information to the personnel about the project and secure their cooperation, and (2) gain information from the teachers about their spelling programs and schedules. Arrangements were made for the teachers to visit the Computer Assisted Instruction Laboratory at the University.

During the fall months, a person trained in supervisory techniques observed spelling lessons in the classrooms participating in the experiment. In December, meetings were held with the teachers and principals to discuss details in regard to administration of tests, random selection of students, CAI and classroom schedules, and other aspects of the management of the experiemnt. The experimental period was scheduled to begin in January, 1968. Therefore, concurrently with the meetings, the program was being developed. It should be noted that the computer program consisting of 11,745 statements was developed, coded, and debugged in less than four months time. The speed of this development

is somewhat unusual for CAI programs. It was vitally necessary to the success of this project, however, and therefore what was necessary was accomplished with the close cooperation of many people. (The original proposal included plans to begin program development in July, ensuring six months for development of the program. However, funding of the project was not received until somewhat later than this.)

4. Schedule of Activities and Treatments

The following is a summary of the schedule of activities and treatments for the project:

September - December:	Developmental Phase: planning program organization and flow, programming, inputting, debugging
October 9:	general draft of program outline completed
October 18:	orientation meeting with Radio Park teachers
October 25:	orientation meeting with Park Forest teachers
November 6:	CAI demonstration for teachers
December 14:	information sheet sent to teachers
December 31:	progress report on Developmental Phase submitted
January - April:	Instructional Phase: operating in the schools
January 2:	installation of student terminals in the schools
January 3:	spelling pretests and attitude scales administered in public schools
January 4:	students randomly selected, scheduled
January 5:	orientation for CAI students
January 8:	operation of CAI Spell began in public schools

January 19:	spelling pretests and attitude scales administered in parochial school
January 22:	CAI attitude scales administered to public school students (first time - third week)
January 24:	operation of CAI Spell began for parochial school
February 5:	CAI attitude scales administered to parochial school students (first time - third week)
March 4:	CAI attitude scales administered to public school students (second time - ninth week)
March 25-26:	Evaluation Team present
April 15:	CAI attitude scales administered to public school students (third time - fifteenth week) and to parochial school students (second time)
April 19:	Instructional Phase terminated
April 22:	posttests and attitude scales administered[2]
May - August:	Final Report Phase: analysis of data and preparation of final report

5. Student Participation: Public Schools

Approximately one-third (75) of the pupils in the sixth grade classes of two public schools, Radio Park Elementary School and Park Forest Elementary School, were assigned to the CAI program for spelling instruction, on a stratified random basis. Stratification was done with the combined achievement scores from the spelling section of the California Achievement Test (Test 6, Form Z) and a dictated list of 25 spelling words.

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[2]Students completing the CAI spelling program previous to the end of the fifteen week period were given posttests at that time.

(Information on test selection and development is given in Section B-2.) Using the total combined scores, pupils were subdivided into equal-sized high, middle, and low spelling achievement groups within each school, and from these achievement (or spelling ability) strata, equal-sized CAI groups were randomly selected. Equal-sized control groups, from among the larger number who would receive conventional classroom instruction, were also randomly selected. Figure 1 indicates the number and range of scores for each group.

Groups	Schools					
	Radio Park		Park Forest		Our Lady*	
	n	range	n	range	n	range
High	14	36-51	11	33-52	13	41-50
Middle	14	25-35	11	24-32	11	28-40
Low	14	4-24	11	2-23	13	14-27
Total	42		33		37	

Figure 1. Number and range of scores of students assigned to CAI and conventional instruction groups.

*Assignment only to CAI instruction, note also it was impossible to assign equal-size groups.

The students in the CAI groups were assigned to two twenty-minute periods of CAI spelling per week. The instruction began the week of January 7 and ended the week of April 19, for a total of 15 weeks.

During the time the remaining students (control group) had their classroom spelling lessons, the CAI group had supervised study periods.

The teacher-assistant met with the CAI students in the libraries and provided various instruction or help for the students, much of which was suggested by the teachers. A few slow readers spent their time working on reading with the teacher-assistant, some groups worked on science materials, and some used the time for other reading or studying.

Occasional information or work sheets, containing materials other than the regular spelling words, were distributed to the students. These sheets were concerned with parts of speech, dictionary skills, handwriting skills, and words for good spellers. The information was not a part of the CAI spelling program but was similar to that contained in the spelling workbooks[3] used by the control students. (The workbooks of the CAI students had been collected previous to beginning the experiment, so that the CAI treatment would not be confounded by this variable.)

6. Student Participation: Non-public School

Pupils in Our Lady of Victory School (non-public) used a spelling series other than the one on which the program was based. Because they wished to continue with this, and because some transportation difficulties were anticipated, pupils from this school participated on a voluntary, after-school basis when it would not be detrimental to the continuity of their program. (The after-school time was set at the request of the principal.)

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[3]Kottmeyer, William and Ware, Kay. Basic Goals in Spelling, 6. New York: Webster Division, McGraw-Hill Book Co., Inc., 1964.

There were 37 sixth grade students from Our Lady of Victory School (of 41 in the class) who desired computer-assisted spelling instruction. They were divided into five groups and each group was transported to Radio Park Elementary School one afternoon a week. Afterward, transportation to their homes was provided.

Each student received approximately thirty minutes of terminal time once a week for thirteen weeks beginning January 22 and ending April 19. With the exception of the decrease in terminal time, they received the same programming and testing sequence, and the same terminal supervision, as the public school children received.

However, since the Our Lady of Victory pupils received regular classroom instruction during the time they participated in CAI, with a different spelling series than the public school, and since there was no comparison group, their data have been handled separately in the final evaluation.

7. Personnel Involved in the Project

The close cooperation of many people is of course involved in a project of this type. In addition to the necessary interaction of the project directors, principals, and teachers, three groups of personnel were highly instrumental in the success of the project:

a. Authors: The development of the CAI spelling program involved the structuring of the content, organizing the words into meaningful presentation groups, planning for the mode of presentation, determining how best to use the facility of the computer, including decisions on the types of branching and the use of the counters and switches which make this branching possible. The organization of the program is indicated

for the first 37 words by the chart presented in Appendix B. The second phase of the work of the authors involved the actual coding of the program in COURSEWRITER I, so that it was ready for key-punching and computer input. After this phase, the debugging or correction of all errors assured a comparatively smoothly running program.

B. Technicians: Several types of technicians are necessary to the use of CAI. First of all are the key-punch operators who input the program. Second are the technicians who, though unseen, operate the computer and its components. Third are the staff who maintain and repair the system. In addition, of course, are those responsible for installation and related aspects.

C. Teacher-assistants: These teachers supervised the students when they were using the terminals. Their duties included:

(1) Aiding students in signing on and off
(2) Replacing and adjusting tapes, slides and paper
(3) Keeping daily, weekly and final summary logs of students terminal usage and place in the program
(4) Rescheduling students when necessary
(5) Demonstrating the terminal and program to visitors
(6) Keeping a log of visitors
(7) Filing carbon copies of students' print-out sheets
(8) Recording any possible corrections that might improve the program
(9) Reporting needed equipment maintenance or repair

1. Development of the CAI Spelling Program

Objective 1. To develop and revise a CAI program on spelling for sixth graders.

This first objective was an integral part of, and preceded the implementation of the other objectives. Using a basic list of spelling words, the CAI program SPELL was developed for the presentation of spelling to sixth graders. The basic list (Appendix C) included 216 words from Units 19 through 35 in the workbook series used by the sixth graders in the State College Area School District. Classroom instruction previous to implementation of CAI covered the first 18 units.

The total program of SPELL has six major parts, each part including words from two or three units of the workbook. Units 24 and 30 were not used as they were review units. Figure 2 shows the distribution of words in the program.

Parts	Workbook Units	Number of Words
Spell 1	19, 20	28
Spell 2	21, 22, 23	43
Spell 3	25, 26	26
Spell 4	27, 28, 29	44
Spell 5	31, 32, 33	43
Spell 6	34, 35	30

Figure 2. Distribution of words in SPELL

Incorporated into the six parts of SPELL, in addition to the basic spelling words, were *"Help"* sections for review of misspelled words, *"Remedial"* sections for concepts, and *"Extras"* for the student demonstrating profiency in spelling.

All parts and sections made use of slides and/or tape messages. In all, 142 slides and 128 tape messages were created for the program.

a. Presentation of Basic Word List

The basic spelling list was given in groups of six to nine words in the form of *"Pretests"*. Each *"Pretest"* was presented in one of three ways:

(1) Tape: A tape message was played that included the pronounced word, a sentence using the word, and the word. The student could have the tape message repeated by typing an "r".

Samples of the words and sentences are given in Appendix D_1.

(2) Slide: The slide displayed had a picture and/or sentence with a missing word. The picture represented the word needed to complete the sentence. The slide remained in view until the student typed the correct word.

An example of such slides is given in Appendix D_2.

(3) Flicked Slide: A slide displaying the spelling word was displayed for a period of five seconds. These

were referred to as "flicked" slides. The student could review the slide by typing an "r" for repeat. Samples of the program for two of these methods of presentation are given in Appendices E_1 and E_2.

The computer program (differentiated from the spelling program that the students actually saw) was written with function statements that "called in" the proper slide or tape message. The function statements are a series of instructions to the computer.

b. Processing the Student's Answer

If the student correctly typed the word, reinforcement was given. The fact that the word was correctly typed on the first try was stored in the computer by the use of a counter, and the program moved on to the next word or to a decision point. (See the flow chart in Appendix F.) If the student misspelled the word, two or more operations occurred: 1) this information was stored for future presentation of the word in a *"Help"* section, 2) various letter combinations in the misspelling were searched for and this information was stored, 3) a partial-answer-zero (Pa0) function was put into operation. The Pa0 function processed the misspelled word for letters that matched the correct spelling. The matched letters were then typed in black with spaces to indicate unmatched letters. The student next made a second attempt to correctly type the word. This procedure was followed three times. The fourth time the Pa0 function was changed, so that the entire word was typed with the unmatched letters in red. (For an example, see Appendix E_1.) When the student correctly typed a word, reinforcement was given with a word or phrase

as "good," "right," "fine," "correct," "very good," etc.

c. Review of Misspelled Words

If in a *"Pretest"* a word was misspelled on the student's first attempt, a switch was used to store this peice of information. At eleven different places in the program a check of these switches was made, or a *"Review"* for misspelled words. The number of words reviewed varied in each section. The switches available for use determined how long the information could be stored. The computer program indicated the *"Review"* by typing the following message to the student:

> *You may have been having some difficulty spelling or typing some of the words. Let me check and see.*

A *"Help"* section for every word in the basic list was written and included in the computer program. Words were presented in one of two ways. Figure 3 gives an example of the most frequent *"Help"* presentation, and is what the student saw on the typed print-out. The misspelled word was typed in red at varying times. The text indicated by * was different for each word. It called attention to various aspects of meaning, syllables, double consonants and vowels, and unusual letter combinations and sounds.

A variation for the presentation of misspelled words was the use of a slide flick. A slide with the typed word, sometimes having a second typing showing the syllables, was shown to the student for five seconds. Figure 4 shows an example of this presentation. The student was shown the slide three times. If he was still unsuccessful in spelling it, the word was typed correctly for him to copy.

You missed the word commerce.
Look at it carefully.
*It means trade or business.**
*The word is divided between the double m to form the syllables**
com - merce.
Close your eyes and try to see commerce.
Now type the word.
(Student's response)
O.K.
(or, if incorrect)
Not quite right -- type commerce.

Figure 3. Print-out for *"Help"* presentation.

Watch the screen for a word you missed. After the slide is turned off, type the word.
(Student's response)
O.K.
(or, if incorrect)
Watch the screen and try again.

Figure 4. Print-out for slide flick.

After the presentation of all misspelled words in a *"Review"* section, the student was branched back into another *"Pretest"*, a *"Remedial"* branch or an *"Extra,"* depending upon the decision factors written into that part of the program. (See flow chart in Appendix F.)

d. Remedial Sections

Twelve remedial sections were written and incorporated into the program. The decision to branch a student into a remedial section was based on information collected during his initial attempt to spell certain words. The information included (1) if the word was misspelled, and (2) how the word was misspelled.

The actual amount of a remedial section that a student received depended upon the correctness of his responses within the section. As soon as he demonstrated a proficiency in, and an understanding of the concept, he was branched to another part of the program.

The actual content, approaches to, techniques used, and lengths of these sections varied greatly. Tape messages and slides were frequently used. The student's responses were an integral part of each section. An example of a remedial section of the program is given in Appendix E_3.

Figure 5 gives the twelve remedial sections, the concept(s) each was based upon, and the decision factor used for branching a student into each section.

Some of the words from the basic spelling list were used to test a student's understanding and proficiency. If he spelled the word correctly, it was eliminated as a misspelled word in the *"Help"* section.

e. *"Extras"* for Enrichment

Six sections called *"Extras"* were written and incorporated into the program. The purpose of these was to provide enrichment for students demonstrating proficiency in the basic spelling lists. The decision to

Remedial Section	Concepts	Decision Factor
1	Root words and adding suffixes, retaining "e" when adding "ment."	Misspellings of suffixes "ment," "al," "ship," and "hood."
2	Sound of "tion" as a suffix or part of a word.	Not including the "t" or other misspellings of "tion."
3	Sound of "ion" and examples.	Misspellings of the "ion" portion of words.
4	Meaning of, and adding a prefix to a root word.	Misspellings of the prefix portion of words.
5	No specific rules, generally when a word is abbreviated, letters are left out and a period is added.	Number of incorrect abbreviations.
6	Rules and examples of showing possession with use of apostrophe--s and s--apostrophe.	Number of misspellings of words showing possession.
Review Few	Dropping the "e" before adding "ing."	Number of time "e" was retained forming "ing"
7	Forming plurals, when to add "s," "es," and change "y" to "i" and add "es."	The number of times the ending of a plural was incorrect.
8	How words are divided between double consonants to form syllables.	The number of words misspelled from a group with double consonants.
9	What homonyms are, and common examples of them.	Number of homonyms misspelled.
10	The final silent "e," how it affects the sound of other vowels.	Number of times student did not add or type the final "e" on a word.

Figure 5. (continued on the next page)

11	Various combinations and sounds of double vowels, the first usually being heard.	Number of times a student did not type the correct double vowel combination

Figure 5. Content of remedial sections.

branch a student into an *"Extra"* was based on 80% or more of the words from the previous pretests having been spelled correctly and the number of remedial branches entered.

The seventy-one words in the *"Extras"* were words that did not appear in the basic spelling list. They were selected from lists of words frequently misspelled by intermediate grade students.

All six *"Extras"* were presented on slides. Three were proofreading exercises, one using incorrect homonyms. The student typed the correct spelling for each word. Two, called "Find the Word," had rows of letters that contained complete words. Students were given clues to "Find the Word." One slide presented a diagram of the state of Pennsylvania. Students were asked to type the correct proper nouns, as names of cities, that were located on the diagram. See Appendix E_4 for a sample.

2. Comparison of CAI and Conventional Spelling Instruction

Objective 2. To compare a spelling program offered via CAI with a program using conventional procedures.

a. Selection and Development of Instruments

It was decided that for the achievement measure which would be used as a pre- and posttest, a composite set of tests should be used, partly standardized and partly derived from the spelling words being taught in the District's schools. Therefore two answer modes were used, multiple choice and free response. Since the District had copies available (but would not be using them as part of the regular achievement test battery during this year), it was decided to use Form Z of the California Achievement Test for the pretest and Form W for the posttest. A list of fifteen words was randomly selected from the more than 200 words which would be presented to the pupils during the experimental period; one was randomly selected from each of the units in the textbook. To assure sufficient range for the test, a list of ten additional words was randomly selected from among the more difficult words being studied in the classrooms when they were observed in the fall months. These 25 words were to be presented in the usual form for a classroom spelling test: each word was given, used in a sentence, and then repeated. (See Appendix G for a list of the 25 words on the test.)

To measure attitude, two attitude scales were developed. The first scale was intended to measure attitude toward spelling. This scale is reproduced in full, together with instructions, in Appendix H_1. The

second scale was designed to assess attitude toward CAI. Appendix H_2 contains this scale along with the instructions.

Both scales were developed according to a Likert format. The Spelling Attitude Scale consisted of 20 items, equally balanced in terms of positive and negative wording. The CAI Attitude Scale was composed of 17 items, nine positively worded and eight negatively worded. The student could respond to each item according to his degree of favorability (or unfavorability) toward that statement. Four response choices were provided: strongly agree, agree, disagree, and strongly disagree.

The initial writing of items was based on expressions of affect which were thought to be consistent with the complex of feelings which elementary school students might have toward spelling and toward the CAI situation.

Item analyses following the technique described by Edwards (1957) for Likert-type scales (summated rating scales) revealed that the items on both scales demonstrated adequate discriminatory power. A measure of internal consistency of each scale was obtained using Coefficient Alpha (Cronbach, 1951). Pretest estimates of internal consistency for the Spelling Attitude Scale and the CAI Attitude Scale were .85 and .83, respectively.

The scoring of both scales followed the same method. A scoring of each item was done such that the higher the item score, the more favorable the attitude. With consideration to each response choice and to whether the item was positively or negatively worded, an item score was formed as indicated in Figure 6.

Response choice	Positively worded item: Scored Response	Negatively worded item: Scored Response
Strongly agree	4	1
Agree	3	2
Disagree	2	3
Strongly disagree	1	4

Figure 6. Scoring of attitude scale items.

After the item scores were formed, they were added together to form a total attitude score. The interpretation of the total score is that the higher the score the more favorable the attitude toward the psychological object (attitude toward spelling or toward CAI instruction, in this case).

A questionnaire to determine parental reactions was prepared for distribution at the end of the experimental period. The questions on this are included in Appendix I.

b. Results of Statistical Analysis: Achievement and Attitude

The data in this study were analyzed according to analysis of variance techniques and correlational methods. First to be discussed will be the results of the analysis of variance. The dependent variables included in these analyses are as follows:

1. Spelling achievement variables (scores on all Ss in the study)

a. Posttest standardized achievement.

b. Posttest total achievement.

2. Attitude variables

a. Attitude toward spelling (scores on all Ss in the study)

b. Attitude toward CAI (scores on Ss in CAI group only)

The analyses dealing with variables in which all Ss in the study were assessed (attitude toward spelling and both achievement variables) have one feature in common, namely, that the independent variables are the same in each case. These independent variables are teaching method (conventional and CAI) and ability level (high, middle, and low 33%). Those analyses dealing with the variable, attitude toward CAI, have ability as the only independent variable.

There were two schools in which students had been randomly assigned to an experimental group (instruction via CAI) and to a control group (conventional instruction). A third school (non-public) was involved in the project; however, all the students in this school received CAI instruction in addition to conventional instruction. This means, of course, that no comparisons can be made between CAI and conventional instruction for the third school. Under some circumstances it would be appropriate to conduct analyses of variance using a randomized block design in which schools are included as a replication. In the present situation, however, the cut off scores by which ability levels were formed were different for each school; consequently, a confounding of the ability factor could easily occur. Therefore, separate analyses of variance were performed for each school.

(1) Standardized Achievement

The analysis of variance tables are presented in Appendix J, Tables 1, 2, and 3 for schools 1, 2, and 3, respectively. The tables of means for these analyses are presented in Appendix K, Tables 1, 2, and 3. It should be noted that the statistical analyses for schools 1 and 2 follow that of a Lindquist Type III design in which there are two between groups variables and one within groups variable. For school 3 the analysis is that of a Lindquist Type I design in which there is one between groups variable and one within groups variable. A within groups variable has reference to repeated measures, which, in the present situation, is the pretest and posttest. The readers is referred to Chapter 13 in Lindquist (1953) for a detailed explanation of these designs.

For school 1 there were no significant interactions or significant main effects for instructional method or Pre-Post. This latter term refers to the difference between mean pretest and posttest scores. The only significant effect was that of ability level. An inspection of the means reveals that large differences occurred in the usual direction, ie., the mean scores become progressively larger as one moves from low to high ability.

The analysis for school 2 revealed a significant interaction between ability level and Pre-Post which indicates that the way in which the ability groups differed between pretest and posttest was not the same for the various ability levels. This effect seems to arise from the rather large 'gain,' ie. difference between pretest and post-test means exhibited by the low ability groups across both conventional

and CAI groups, whereas very little difference occurred between pretest and posttest for the middle and high ability groups for both instructional groups. The means being contrasted here are not presented in Table 2. These means are given below in the following order: hi ability - Pretest, hi ability - posttest, . . . , low ability - posttest: 25.43, 25.54, 22.00, 22.21, 13.93, and 18.29. As may be noted from these means the difference between pre and post standardized achievement for the high and middle ability groups is less than 1.00, whereas the difference for the low group shows a 'gain' of 4.36. Using Scheffe's procedure for multiple comparisons among means (Scheffe, 1959), the latter difference was found to be statistically significant. It is possible the regression effects are entering the picture such that Ss in the low ability group have a much greater opportunity to improve than Ss in the higher ability groups. It is possible that a ceiling effect on the standardized achievement test makes improvement by Ss in the higher ability groups, who are also higher in terms of pretest score, more difficult. Again, no significant main effect was found for instructional method.

In school 3 no significant differences appeared except for the ability main effect.

(2) Total Achievement

The analyses of variance on total achievement follow the same statistical designs as were used in the standardized achievement variable. The tables displaying the results of the analyses of variance for schools 1, 2, and 3 are presented in Appendix J, Tables 4, 5 and 6. The corresponding means are displayed in Appendix K, Tables 4, 5, and 6.

The results of these analyses reveal essentially the same pattern as that found in the analyses on standardized achievement. For each school a highly significant ability effect was found. An examination of the means reveals differences in the usual direction, ie.,the means become progressively larger as ability level increases.

For school 1 a significant difference was found between pretest and posttest. Since no significant interactions were present for the within group variable the differences are across ability levels and instructional method. The means being contrasted here, then, are the overall means for pretest and posttest which are 26.86 and 30.27, respectively. Thus the overall 'gain' from pre to post administrations is significant. The only other effect which revealed significance was that between ability levels.

It may be interesting to note that in the CAI group the difference between the pre and posttest means increases as ability level decreases whereas this trend fails to appear to the same degree in the conventional group. More specifically, the low ability group makes a 'gain' which is slightly less than that occuring for the middle ability group. The differences between pretest and posttest were evaluated for each of the six ability x instructional method cells depicted in Table 4 (Appendix K) using Scheffe's procedure for multiple comparisons. Significant differences were found for the CAI middle ability group and the CAI low ability group. It should be noted that no such significant differences were found for the three ability groups who received conventional instruction.

In the analysis for school 2 a significant interaction appeared between pre - post and ability level which indicates that the way in which the ability groups differed between pretest and posttest was not the same from level to level. The means for the groups under consideration are presented below in the following order: high ability - Pretest, high ability - posttest, . . ., low ability - posttest: 40.14, 42.71, 30.96, 35.04, 16.64, and 24.61.

The differences between pretest and posttest is 2.57, 4.07, and 7.96, respectively. The latter two differences were found to be significant according to Scheffe's procedure. As may be noted the difference between the pre-post means increases as ability level decreases such that the difference observed for the low ability group is slightly more than three times as great as the difference obtained for the high ability group. It is probable that regression effects account for a substantial portion of this finding. There is also the possibility that the low ability group is profiting more from instruction. In contrast to the findings for school 1 it may be pointed out that the low ability group who received conventional instruction demonstrated a significant 'gain.' When the differences between pretest and posttest are tested via Scheffe's procedure for each of the six ability x method cells depicted in Table 5 (Appendix K) two comparisons emerged as significant. The significant 'gains' were found for the low ability group in both conventional and CAI instructional methods. It would appear that the low ability groups profited most from instruction although, as before, a portion of this finding may be attributed to regression effects.

For school 3 no significant differences were noted between pretest and posttest, nor were there any significant interactions. Only the ability effect was significant, with the means showing a progressive decrease in size from high to low ability levels.

(3) Attitude Toward Spelling

The analyses of variance on spelling attitude follow the same statistical designs as were used for standardized achievement and total achievement. The tables presenting the results of the analyses of variance for schools 1, 2, and 3 are given in Appendix J, Tables 7, 8, and 9, respectively. The mean scores for spelling attitude are given in Appendix K, Tables 7, 8, and 9.

For school 1 no significant differences occurred between the pre and post administrations and no significant interactions were found. There were significant differences between ability levels and between instructional methods. An inspection of the means reveals that there is a fairly consistent pattern across ability levels. That is, the means tend to decrease from high to low ability. The lone exception occurs in the middle group who received conventional instruction. Here the mean attitude score did not show a decrease. The significant main effect for instructional method occurred as a result of a higher mean score for the CAI group than for the conventional group. This does not mean, however, that the CAI group had a more positive attitude toward spelling as a result of the instructional treatment. An inspection of the means shows that both pre and posttest scores tended to be higher for the CAI group.

And, as alluded to earlier, no significant changes in attitude occurred between pre and post testings.

The results of the analysis of variance for school 2 revealed a significant interaction between the pre-post administrations and ability level. This finding indicates that the way in which the pre-post administrations differ, varies from level to level of the ability factor. The mean scores being contrasted in this situation are presented below in accordance with the following order: high ability - pretest, high ability - posttest, . . . ,low ability - posttest: 67.00, 66.50, 61.21, 64.21, 57.14, 58.75.

The only contrast found to be significant by Scheffe's procedure was that between pretest and posttest for the middle ability group. An inspection of the means reveals that the difference noted between pre and post administrations of the spelling attitude scale is in a positive direction, ie., some increase in favorability toward spelling occurred.

For school 3 no significant differences were obtained between pretest and posttest, nor were there any significant interactions. Again the difference between ability levels occurred. Inspection of the means reveals that favorability toward spelling decreases as ability level decreases.

(4) Attitude Toward CAI

The statistical analysis on attitude toward CAI for all three schools followed a Lindquist Type I analysis of variance. The tables presenting the results of the analyses of variance for schools 1, 2, and 3 are presented in Appendix J, Tables 10, 11, and 12. The mean scores for

attitude toward CAI are displayed in Appendix K, Tables 10, 11 and 12.

Schools 1 and 2 may be considered together since the results of the analysis of variance were similar in both cases. No significant differences were found between pretest and posttest nor were there any significant interactions. This indicates that no essential change in attitude occurred as a result of experiencing CAI. A significant ability main effect appeared and an inspection of the means shows that favorability toward CAI decreases as ability level decreases.

For school 3 no significant differences occurred for any main effect nor were there any significant interactions.

c. Correlational Analysis

The final analyses to be performed were correlations between certain variables. The correlations were computed separately for each school and are presented in Appendix L. (A list of the variables used in the correlational analyses together with the number representing each variable in the tables is presented on the first page of the appendix.) Tables 1 and 2 (in Appendix L) display the correlations between four variables (total achievement, pretest and posttest, and spelling attitude, pretest and posttest) for schools 1 and 2. The pattern of these correlations is the same for both schools. The correlation between post spelling attitude and pre total achievement was .59 and .45 respectively for schools 1 and 2. Also, the correlation between post spelling attitude and post total achievement was .61 and .57 respectively for schools 1 and 2. This relationship could have been anticipated from the analyses of variance in which significant differences were demonstrated between ability levels

when spelling attitude was the dependent variable and where ability levels were based on the pretest standardized achievement scores. All correlations are significantly greater than zero.

Tables 3, 4, and 5 in Appendix L contain the correlation matrices for the groups receiving the CAI instruction in schools 1, 2, and 3, respectively. The variables being intercorrelated are pre and post total achievement, pre and post spelling attitude, pre and post CAI attitude, relative per cent correct, and average word difficulty. The relative per cent correct was formed by obtaining for each student the number of words completed correctly on the CAI program and dividing that total by the number of words completed. Hence, the resulting percentage score is relative to the number of words actually encountered by the student as he progressed through the CAI spelling program. Furthermore, the measure is independent of the number of words that a student worked through. The higher the relative per cent score, the more words the student had correct on his first exposure to a word.

The average difficulty score is derived from the PaO sequence that a student may or may not encounter as he worked through the words in the CAI spelling program. For purposes of obtaining a score which would be a measure of the average difficulty for a student per word, a scheme was devised as shown in Figure 7.

The scores were then summed across all the words completed by the student and this total was then divided by the number of words completed on the CAI program by that student. A high score represents frequent entry into the PaO sequence and represents difficulty with the words

	score per word
word correct on first exposure	1
PaO 1	2
PaO 2	3
PaO 3	4
PaO 4	5

Figure 7. Scoring of PaO responses.

encountered. A low score indicates a high frequency of words correct on the first exposure to them. Therefore, the lower the score the better the student's performance.

The correlation matrices are presented for the reader's interest; however, there are several correlations to which attention should be drawn. The two indices of achievement in the CAI spelling program, relative per cent correct and average word difficulty, are not independent measures of achievement, as indicated by correlations of -.96, -.97, and -.96 for schools 1, 2, and 3, respectively. Such correlations are to be expected when one considers how each score was actually computed. Consequently, the correlations between the remaining variables and each of these two scores are very similar in magnitude, although reversed in sign. The difference in sign merely reflects the nature of the scoring method. There is a strong relationship between both total achievement scores and the two indices of achievement in the CAI spelling program which replicates across schools. The relationships between the various

achievement variables and the measures of both spelling and CAI attitude seem rather large in comparison to the relatively low correlations characteristically found between achievement and attitude. These relationships indicate that high achievement is associated with more positive feelings toward spelling and toward CAI effects. It is not possible from these data to separate causes from effects.

d. Data from Computer Logs

The computer stores a great deal of information about how the individual student proceeds in the program. Additional information is available from carbon copies of student print-outs. Since these data supplement the statistical analysis, that which seemed especially important are included in this section.

(1) Amount of Program Completed. The three ability level groupings of students showed considerable variation in the amount of the program completed and the number of words spelled correctly on the first attempt. Figure 8 shows the variation for the groups in respect to these two aspects of the program.

Ability Level Groups	Average Number of Words Completed	Per cent of Program Completed	Average Number of Completed words correct	Per cent Correct of completed words
High	216	100%	182	84%
Middle	213	99%	144	67%
Low	152	70%	61	40%

Figure 8. Averages for words completed and correct.

Appendix M gives a more complete picture for the amount of program completed. Of the 25 students in the middle group, 21 finished SPELL, and the remaining four completed sixty per cent of more of the program. There were only four of the lower ability level who completed the entire program, and the range of progress varied greatly for this group. The low percentage of words spelled correctly on the first attempt meant that *"Helps"* were provided for a large number of words, plus extensive branching into remedial sections. These two factors, in turn, resulted in presentation of fewer words of the basic spelling list in the time allotted for the project.

(2) Common Misspellings. Analysis of the records of pupil responses provided a list of the most common misspellings of words. A sample of some of the common misspellings, with frequency of occurrence, is given in Appendix N.

These data would be of value in future revision of the spelling program. Anticipation of the most frequent misspellings could be built into various parts of the program, such as the *"Pretests," "Help,"* and/or *"Remedial"* sections.

(3) Difficulty of Words. The records of student responses provided data for the relative frequency of correct and incorrect responses. Analysis of the data gives an index of difficulty for the basic spelling words, useful for future program revision. A sample of this type of information is given in Appendix O.

(4) PaO Feedback. Figure 9 indicates the total number and percentage for each sequential PaO feedback. The numbers and percentages are the

combined totals for the 216 words and 112 students, or the entire program and use. The number and percentage of the fourth Pa0 indicate how many times a complete word was typed for students.

	Attempts			
	1	2	3	4
Numbers	3,376	904	418	1,423
Per cent of total	55%	15%	7%	23%

Figure 9. Total use of Pa0.

(5) Use of Individualized Branches. Appendix P_1 indicates the number and percentage of students from the high, middle and low sections who were branched into the various remedial sections. These generalizations can be made:

(a) A higher percentage of students in the low groups were branched into remedial sections. The opposite was true of the high groups.

(b) The majority of students (85%) entered the remedial section on the use of "apostrophe-s" and "s-apostrophe."

(c) The three remedial sections entered with the least frequency were those on prefixes (25%), dropping "e" before adding "ing" (19%), and use of the final "e" (20%).

"Help" sections were used a total of 6,121 times, an average of 54.65 *"Helps"* per student.

Appendix P_2 gives a summary of the number and percentages for the groups of students and for the total who were branched into *"Extras."* The students in the high group were branched into the *"Extras"* with the highest frequency. The variation of the numbers and percentages branched into different *"Extras"* indicates that the difficulty level of preceding words should have been considered in adjusting the 80% achievement level requirements. Data available from the program would now make this possible.

e. Reactions

To supplement the objective data, subjective information was secured through several types of reactions, obtained by questionnaires, free response, and direct questioning.

(1) Student Reactions to CAI. Besides completing the CAI Spelling Attitude Scale, students were asked to write a paragraph about how they felt towards CAI spelling. The following is a random selection of such paragraphs written during the last five weeks of instruction by CAI.

> Computer spelling was fun, and easy to learn, so easy I didn't think I learned all the words. But anyway I enjoyed computer spelling.
>
> I enjoyed working on Computer very much. Although sometimes it makes you so mad. I strongley disliked it when it broke down.
>
> I enjoyed working with the computer very much, although there could be improve at times the computer wouldn't work for fifteen minutes, but you did get through the words without being nervous. You didn't have to study.
>
> I think that the C.A.I. was a good program, because when I misspelled a word that it was nice to kown how to spell it right off. I also think that the terminals broke to often.
>
> CAI is preety neet cool and all that stuff I like CAI spelling a hole lot

> I think that CAI was a great project. I think that it was a worth while project and it helped me very much in learning how to spell. I didn't really mind typing the word on the terminal. I think that the computer made you really feel good when you spelled the word correctly. I think that it was a good project.
>
> Well I think the spelling is a lot of fun. But I wish we had more time and we had a bigger room to work in.

(2) Responses to Final Questions in the CAI Program. Upon completion of the spelling program, students were asked to respond to four questions concerning their experience with CAI. The following chart gives the questions asked and the answers given by the fifty-eight students who completed the program. It should be kept in mind that the majority of these students were from the high and middle groups.

Questions	Responses		
	Yes	Not sure	No
"Do you feel you can correctly spell the words you missed?"	55	2	1
"Do you think you could spell most of the 216 words correctly on a written test?"	49	6	3
"Did you enjoy working on spelling words with me?"	58	0	0
	Helped	Made no difference	Made it harder
"How do you think the typewriter influenced your score?"	40	12	6

Figure 10. Responses to final questions.

(3) Parental Reactions. A parent attitude questionnaire was mailed to the homes of all children who had CAI spelling. Of the 112 forms

mailed, 87 or 77.5 per cent were returned. The majority, 67.8 per cent, were filled out by mothers. Appendix I gives the items on the questionnaire, with the number and percentages for the responses.

The responses of the parents were very favorable, with 86.1 per cent pleased to know their child had been assigned to CAI. The majority (95.4%) said their child was pleased when assigned to the program.

As the CAI program progressed, 94.3 per cent felt their child would prefer CAI to classroom instruction for spelling lessons. The majority (78.2%) felt their child's attitude towards school remained the same, but 66.7 per cent felt their child's attitude towards spelling improved.

Most of the pupils (81.7%) showed their print-outs to the parents and were able to explain the typed material to their satisfaction. Only 16.1 per cent of the parents accepted the invitation to visit the terminals, but 86.3 per cent said they would like to see further experimentation with CAI carried on in the schools.

(4) Teacher Reactions. The sixth grade teachers were supportive of the project, showing continued interest in the project and their pupil's progress. All of them visited the terminals, observing the pupils on line, and many signed on for a demonstration of program content.

As reported by the on-site evaluation committee, teachers commented about improvement in use of possessives and fewer erros in using double vowels. They felt some students had better structural analysis in creative writing. They also noted a physical improvement in a child who had a speech impediment and in another child who had difficulty in motor skill coordination.

3. Comparison of Methods

Objective 3. To compare the relative effectiveness of two methods of teaching spelling, each of which was taught by a CAI program and a conventional program.

As previously mentioned, this objective was not met because of the budget reduction.

4. Demonstration of CAI to Other Districts

Objective 4. To demonstrate the teaching of spelling via CAI to personnel from other school districts.

Logs of visitors and demonstrations were kept by the teacher assistants in charge of the terminals. Demonstrations were given for visiting personnel from Sunbury, Bloomsburg, Bellefonte, Milton, Altoona, Harrisburg, and Philadelphia.

Demonstrations were handled in two ways. If students were on line, the visitors observed them and the project was explained by the teacher assistant. When possible, visitors were signed on for actual terminal use. Over one hundred sign-on demonstrations were given; the majority of these were for local visitors including parents, control students, and personnel from the local schools, The Pennsylvania State University, the local newspaper and the WPSX television station. Further documentation of the dissemination is in Part V.

5. Documentation of Technical Problems

Objective 5: To determine and document technical problems that may occur in the use of CAI in teaching spelling to sixth graders in the elementary schools.

Technical problems recorded by the teacher assistants supervising the terminals were of two main classifications. The majority of the problems encountered were malfunctions of equipment. Other technical problems were due to program errors.

a. Equipment Problems

1. Tape recorders
   (a) Not stopping, rewinding and positioning*
   (b) Belts wearing, breaking
   (c) Tapes breaking, sensing strips coming off
2. Slide projectors
   (a) Not positioning correctly*
   (b) Not displaying correctly*
   (c) Bulbs burning out, slides being caught
3. Terminals
   (a) Broken or incorrect wiring to A-V equipment, causing some of the above problems
   (b) Replacement of typewriter ribbons
   (c) Keys sticking, or not being received
4. Data Phones
   (a) Lines in use

(b) Line interference

(c) Poor connections

5. Computer Center

(a) Power failures

(b) Electronic breakdown, technical difficulties*

(c) Accidental disconnections

(d) Programs not loaded

*indicates most frequent problems

b. Program Errors

Because of the vast number of statements, the complexity of the program itself, and limited time for recompiling the program, previous proofing and revision did not remove all program errors. Such errors were discovered as students proceeded through the program. They did not present major difficulties, as the teacher assistants could type in material to match the error or branch a student past an error. The expense and time involved in recompiling portions of the program made it more feasible for the teacher-assistant to anticipate and handle an error while the student was on line. A record of program errors was kept for possible future rewriting and recompilings of SPELL.

C. Discussion of Implications

This section is divided into parts; the first succinctly points out some aspects resulting from the statistical analysis, while the second outlines some of the general implications of the project.

1. Comments on Statistical Analysis

What does the finding of "no significant differences" mean? In analysis, means are being compared. The finding of "no significant differences" indicates that although the means being compared are observed to be different from one another through inspection, the statistical analysis of these means reveals that they are not statistically different. The means being compared were computed on a particular criterion or dependent variable. Hence, one might find no difference between the criterion means for two teaching method groups. The interpretation is that the two methods had the same effect when a particular criterion is considered (say, an achievement test given immediately on completion of the learning program). No generalization can be made regarding various other possible criterion measures such as long term retention or the acquisition of'principles' when the achievement test assessed only 'factual information.'

In the instances in which data from the spelling program resulted in no significant differences, it may be stated that instruction via CAI is "as effective as" conventional classroom instruction.

Significant gains in standardized and total achievement were found for both the CAI and conventional low-ability groups of school 2,and

for the total achievement of the CAI middle and low ability groups of school 1. Some factors that may have confounded these findings should be mentioned. One factor is that the low-ability CAI groups, who on the average completed 70 per cent of the spelling program, had a range of 25 to 100 per cent completion. Another important consideration is that removing the CAI students reduced class size during classroom spelling instruction. This would have enabled teachers to give more individual attention during spelling instruction, possibly affecting the achievement level of the conventional group. Also, the effect the participation in an experiment had upon both groups of students and classroom teachers can not be determined.

Considering the above and other data summarized in this report, there is indication of need for further investigation of the potential of CAI instruction, especially for lower-ability groups.

2. General Implications of the Project

What implications for the teaching of spelling and for the use of CAI can be stated from this project? The following is a partial list of the many that can be found:

a. Elementary school pupils at the sixth grade level readily accepted instruction by computer. The children, as might be expected, were excited about being "taught by a computer," but by no means over-awed. In general, they looked forward to their turn on terminal, frequently arriving a few minutes ahead of time or requesting extra time. Teachers reported that they did not have to remind most children that it was time for them to go for the computer session.

The children learned to operate the terminals quickly -- by the end of the third session almost all were signing themselves on, and knew the procedures for relaying their responses to the computer, making corrections, signing off. Only when there was a problem with the hardware did the teacher-aide have to intercede, since otherwise the program was planned to maximize interaction with the computer teacher. It seems evident that, had funds been available, the teacher-aide could have handled more than two terminals and more than two pupils at one time.

Lack of typewriting skills represented a minor handicap; it slowed the student. Children who had never typed were few, since almost all had a typewriter available in the classroom which they could use, prior to the CAI work. Those who had used a typewriter but had little typing skill comprised the majority, while a very few others could type with a degree of skill. The children in general, however, did not react as unfavorably toward the need to type as groups of adults who have been observed on the same type of terminal. Considering the slow typing time of many, the fact that so many completed so much of the program within fifteen weeks or less is strengthened.

b. Variations in amount achieved were evident. There is some indication that the low achievers seemed to profit most (as indicated by achievement gain scores) from CAI instruction. This is the group which needs extra teacher time in the classroom -- thus teaching spelling to them costs more money. That this fact -- that the low achiever profits most from CAI -- may also be true in other areas of the curriculum, is a strong point. Where conventional instruction costs are highest

CAI may compare favorably on a cost-effectiveness basis. Thus, phases such as remedial reading at the elementary school level, now offered on an individual or small group basis, and remedial phases of other areas, in many schools not offered at all, may be particularly feasible for CAI presentation. The best use may be even earlier; when we have identified the slow-learning status of a child in any curricular area. CAI may be the most cost-feasible and effective way of teaching him so that he does not need remedial help. This implication certainly needs further study and exploration.

c. It seems possible to readily identify the mode by which children best learn spelling. By presenting a sequence of eight to ten words by audio tape, slide sentence, or slide-flick mode, the way in which each child learns words best, or the primary mode, can be identified. Only if the child does not learn by this mode would words be presented by another mode. Use of this simple procedure could result in more efficient learning of spelling. A CAI program based on characteristics of the learner, something long-discussed in the literature of CAI, could become an actuality.

d. Learning was transferred from the CAI situation to the classroom. Effectiveness of transfer of learning from a CAI sequence is perhaps best illustrated by the sequence on "apostrophe-s." Since 85 per cent of the pupils had this sequence, the effect in the classrooms was concentrated (what only five or ten per cent of the pupils received instruction in on CAI was not likely to be evident in the classroom), providing evidence that pupils not only learned, but transferred from the typing input mode of

the computer instruction to regular spelling needs.

e. Attitude toward CAI and spelling remained positive, despite hardware problems. That the attitude of the CAI group remained as good as it did is particularly surprising in view of a computer break-down during the last week, just prior to the administration of the final attitude scale. The break-down prevented from finishing many who thought they would. The attitude of parochial school pupils, coming during after-school hours, also retained a positive attitude. This is in accord with the results of the administration of attitude scales to groups of adults on CAI; however, the adults are far more vocal about the frustration experienced with programs and hardware.

f. A CAI program can individualize instruction. The varying lengths of time it took pupils to complete the program is a strong indication of time saving for some pupils as well as representing one type of individualization of instruction. The percentage of public school children who completed one semester of spelling in 10 weeks or less was 16%, in 12 weeks or less was 50%, and so on; and only 29% were at a point comparable to those having a spelling program which proceeded at the pace of one unit per week. Had funds been available to operate the terminals, all would have been given opportunity to complete the program. This, however, was not possible, so the range of completion times of 4 hours 6 minutes to 8 hours 57 minutes is not a precisely accurate picture.

The data for the use of *"Remedial"* and *"Help"* sections and the Pa0 function further indicates the degree of individualization in programming, as well as the need of individuals for differing schedules of instruction.

g. Personnel can be quickly trained to develop materials and operate equipment. One of the teachers, who helped to develop the program, had had no previous experience with computer assisted instruction and had never programmed an instructional sequence for CAI before beginning work on the project. Working with someone with prior experience, she quickly learned the author language and the necessary programming and coding skills. That the SPELL program was developed and debugged within less than four months attests to the degree of skill she developed.

The project also demonstrated that teachers or teacher-aides can be quickly trained to operate CAI terminals. The aides received about two hours of instruction prior to the beginning of the operational phase; during this instruction, they were taught how to operate the terminal, how to handle problems, and how to keep the necessary records. While technicians had to be called to repair equipment, the aides did an excellent job of keeping the terminals running. They also served as liaison with the classroom teachers and the aide who was working with the CAI group during their regular classroom spelling time, and they demonstrated the equipment to visitors, answering questions about the equipment and about CAI in general. (As mentioned previously, they could have handled more terminals than the two per school which were operating during the experiemental period.)

II. Describe project endeavors in which the anticipated results have exceeded expectations, and those in which results have not measured up to expectations.

A. Exceeded Expectations

The project exceeded expectations in the following ways:

1. This project serves as a positive example of a successful cooperative venture between a public school district, local parochial school, and university. The University personnel have been extremely effective in all their efforts to make this project an outstanding one.

2. The ease with which teachers, who had no prior experience with computer-assisted instruction, were trained to work with students on the terminals was significant in our opinion.

3. The almost unanimous interest and approval received from parents of children participating in the CAI program more than exceeded our expectations. An exceptionally high percentage of parents returned the Parent Reaction Form. In addition, others expressed a great deal of interest in the project, as witnessed by the number of visitors, sign-on demonstrations, and requests for talks to such groups as the Parent Teacher Association. Questions from these groups centered on what CAI is, and its potential for our elementary schools, as well as on the reactions of the children.

B. Expectations Not Met

Ways in which the project did not measure up to expectations include:

1. Equipment "break-down" had a deleterious effect on the continuity of the program. The difficulty with the hardware is one not uncommon to computer-assisted instruction at this stage in its development. The link between the computer and the audio-visual components of the terminal in particular is a very sensitive one. Constant modifications in the hardware are being made to resolve the type of technical problems which were met in this project. The teachers and the pupils are to be commended for the manner in which they accepted the terminal difficulties and the down time of the computer itself.

2. Because the initial budget was reduced by one-third, a portion of the original plan for the project was eliminated.

III. Report the effect of the project on the educational institution or agency by discussing what you consider to be the greatest change resulting from the project.

Additional interest has been generated in school district personnel to learn more about the possibilities of computer-assisted instruction. Positive teacher attitudes toward the program, which initially existed, have been sustained. The location of the terminals, at times became a cause for concern by some classroom teachers whose students were involved in the program. This may have had some bearing on overall attitudes.

However, after the completion of spelling instruction by CAI, the overall attitude toward the program tends to be a positive one.

Some of the teachers have indicated interest in exploring the possibilities of developing CAI programs for other areas of the curriculum. One of the minor considerations in selecting spelling was because it was the type of subject in which teachers frequently find it difficult to generate a great deal of enthusiasm for teaching. Therefore, the threat of the computer replacing the teacher, a psychological threat very real to many classroom teachers, would be minimized, since it was hypothesized that they would not feel as threatened if the computer were presenting material which they did not greatly enjoy teaching anyway. However, the teachers involved in this project expressed interest in using the computer to present the curriculum areas in which they were most interested. If this type of interest can be used in developing CAI programs, the implementation of the coordination of computer-assisted instruction with classroom teaching may be realized.

IV. Report the effect of the project on the cooperating agencies.

A. Cooperating Agencies. Representatives of the following agencies cooperated on the project:

1. State College Area School District

a. Radio Park Elementary School

b. Park Forest Elementary School

2. Our Lady of Victory Parochial Elementary School

3. The Pennsylvania State University

a. Center for Cooperative Research with Schools (CReWS)

b. Computer Assisted Instruction Laboratory

4. Title III Area J

5. Pennsylvania State Department of Public Instruction

B. Results of Cooperation. As stated previously, the cooperation was unique and all personnel in all agencies worked in a smooth and coordinated fashion to develop a CAI spelling program, to compare it with conventional classroom instruction, and to present information about it to others.

C. Changes of Agencies Involved. There were no changes of agencies involved in this CAI program. The first three agencies enumerated above are all located in Centre County, while the others aided in dissemination outside the county.

V. Discuss how project information was disseminated.

Information about the project was disseminated in various ways:

A. Several different news articles about the project appeared in

the Bellefonte-State College Centre Daily Times, and were distributed for use in other newspapers.

B. Presentations describing the project were made to five area Parent-Teacher Association meetings and four University classes.

C. Inquiries for information about the project have been received not only from local, area, and state agencies, but from other states as well (as far distant as California). At least a dozen copies of the program have been sent out in response to written inquiries.

D. As noted previously, over 100 persons signed on for demonstrations during the time project was underway in the schools. In addition, many others observed the pupils at work.

E. A television program on the project was presented during March. Representatives of WPSX-TV, the local NET station, taped a sequence which included an explanation of the project, viewing of pupils on terminal, and questioning of pupils for their reactions.

F. Articles for publication in educational journals are being prepared.

G. The invitational conference to further disseminate information and discuss the results and implications of the project was deleted due to the budget reduction.

VI. Describe the methods and procedures being developed to carry the project forward without Federal support after the designated approval period.

Personnel from the School District have investigated the possibility of utilizing their IBM 1130 computer to continue this program, but found that the equipment is not sufficiently sophisticated to handle CAI instructional programs. As program costs are reduced, the District will investigate the possible extension of this program, and others, utilizing computer equipment at the University.

VII. List costs for budget period this narrative report covers.

A. $53,115 Total cost.

B. $ 2,800 Total non-Federal support

C. $50,315 Total Federal support under Title III, P.L. 89-10

D. $ none Total Federal Support other than Title III, P.L. 89-10

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of Instruction Section (pages 19-31)

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APPENDIX A

Review of Related Literature

As E. Horn (8) notes, "The chief aim of spelling has been, and remains, the acquisition by the child of permanent ability to spell words correctly." To achieve this goal, he asserts that spelling instruction be an individualized program which is focused upon each child's spelling difficulties. Further (12) he maintains, "Spelling ability is important, even though spelling may be a minor subject in the curriculum. Spelling errors detract from the effectiveness of any written work. . . . The advantages of good spelling ability and the disadvantages of poor spelling ability amply justify careful, systematic planning for helping pupils spell correctly."

Although many techniques for teaching spelling have been proposed, research findings have offered conflicting evidence regarding their relative value. One can discover research to support practically any approach to the teaching of spelling.

A substantial number of research-based articles have directly or indirectly advocated emphasis on phonics instruction. For example, Aaron (1) found that skill in the spelling of phonetic syllables seems to be predictive of spelling achievement. And, Newton (14) concluded that, of the abilities and skills he investigated, the ability to spell phonetic syllables is the greatest contributor to spelling accuracy.

Similarly, Holmes (7) reported that spelling ability at the high school and university levels seems to depend to a large extent upon ability to handle phonetic association. This phonetic experience may

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be meaningful much earlier, for Russell (19) finds that auditory abilities and spelling achievement, at the primary level, appear to be related. However, considerable contribution to spelling variance was unaccounted for, indicating the possibility that visual discrimination factors, as well as a wider range of auditory skills, should be analyzed. In a previous study, Russell (20) had reported on the characteristics of good and poor spellers, concluding that poor spelling ability is closely related to poor auditory discrimination and visual differentiation. Interestingly, high spelling ability was not found to be related to superior discrimination.

On the other hand, among those investigators who contend that phonics has a far lesser impact of spelling excellence, is Petty, whose report (17) deals with determining the existence of a relationship between the following: the persistence of spelling difficulties in socially-useful words, and the presence of particular phonetic elements in these words. Contained within his summary are the statements that there appears to be no recognizable pattern for misspellings, and that certain phonemes, selected for study because they indicated some relationship to the persistence of spelling difficulty regarding the words containing them, could not directly show such a relationship. Petty, therefore, concluded that emphasis should be placed on learning each word as an individual problem.

Many studies have been conducted comparing spelling ability with other variables. Correlations between phonic knowledge and spelling were noted by Templin (21) to be somewhat higher than those between the former and reading. Soon afterwards, Furness (4) reported a correlation between

(APPENDIX A - continued)

reading and spelling test scores of .80 and .85, as compared with a relationship of .30 and .40 between intelligence and spelling.

E. Horn (9) proposed that the following evidence be evaluated in considering the potential contributions of phonic instruction to spelling:

(1) Children should learn the ways in which each sound is spelled.

(2) They should learn how to spell the principal prefixes and suffixes and how to add these to base words.

(3) They should learn such orthographic aids as apply to large numbers of words.

(4) Help may be gotten from knowledge of word patterns, but there is need for direct teaching of the large number of common words which do not conform to rules.

Some corroboration is offered by Otterman (16) who concludes that thirty ten-minute lessons on prefixes and root words result in higher spelling scores. Mason (13) tackled the problem of whether word discrimination can be taught as an isolated process, and correspondingly, whether spelling skill could thus be increased. His conclusion is that word discrimination is taught with concomitant enhancement of spelling skill. Regarding any negative effects of the syllabic presentation of words, T. Horn (10) notes that evidence is inconclusive and suggests that attention to syllabic elements is desirable but not as a basic method of teaching spelling. In disagreement with this, Osburn (15) proposes that pupils be taught fifty "key syllables" which they will most often need.

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"An enormous amount of research," writes E. Horn (12), "has been done in an effort to determine the best methods for learning to spell a word. The findings of research are incorporated in a series of steps in learning to spell a word. These steps are rather uniform in most modern spelling books, and involve the following:

(1) pronouncing each word,

(2) looking carefully at each part of the word as it is pronounced,

(3) saying the letters in sequence,

(4) attempting to recall how the word looks and saying the letters,

(5) checking this attempted recall by looking at the correct spelling of the word,

(6) writing the word,

(7) comparing the word as written with the correct spelling of the word."

The only rules which should be taught are those having wide application to a great number of words, and having few exceptions, such as:

(a) addition of suffixes (converting y to i, omission of final silent e, doubling final consonant, et cetera)

(b) q is invariably followed by u

(c) English words do not end with v

(d) proper nouns and most adjectives formed from proper nouns typically begin with capital letters

(APPENDIX A - continued)

(e) use of periods in abbreviations

(f) use of the apostrophe E. Horn (8)

E. Horn (12) reports that research has consistently shown that it is more efficient to study words in lists than in context. Specifically, he cites evidence that words studied in lists are learned more rapidly, retained longer, and transferred more readily to new contexts. In a recent article, T. Horn (11) makes the following points:

(1) The list presentation of words is more effective than contextual presentation.

(2) The test-study method is superior to the study-test method of instruction.

(3) The corrected-test techniques is the most efficient single procedure for learning to spell.

(4) Marking the difficult spots in words has little or no value.

(5) The most promising form of word analysis appears to relate to suffixes.

E. Horn adds (8) that tests given before study (i.e. the test-study method) disclose the words as yet unlearned to both teacher and pupil, which is economical in terms of effort and minutes, and also motivates the pupil's work. In contrast to Horn's findings, Hahn (5) discovered the contextual method was as effective and efficient as the columnar method; moreover, the pupils' attitude was more favorable toward the contextual method. Motivation is usually found a relevant factor in many kinds of learning. Coard (3) reports that students identified

(APPENDIX A - continued)

indifference as the greatest obstacle to better levels of performance. Petty and Plessas (18), and Christ (2) have likewise stressed the importance of motivation.

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(APPENDIX A - continued)

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APPENDIX B

Organization of SPELL

section	label	word	a-v method	concept	counter	switch
intro 4	1-1	holy	tape/	ending y		s1
Unit 19A	1-2	easily	sentence			s2
	1-3	slippery				s3
	1-4	military				s4
	1-5	copy				s5
	1-6	windy				s6
	1-7	silly				s7
intro 5	1-8	tardy	slide/	ending y		s8
Unit 19B	1-9	daily	picture			s9
	1-10	thirsty				s10
	1-11	tiny				s11
	1-12	empty				s12
	1-13	cherry				s13
	1-14	ugly				s14
intro 6	1-15	excitement	tape/	suffixes	c1	s15
Unit 20A	1-16	settlement	sentence	('ment')	c1	s16
	1-17	amusement			c1	s17
	1-18	development			c1	s18
	1-19	instrument			c1	s19
	1-20	community		('ity')	c1	s20
	1-21	safety		('ity')	c1	s21
	1-22	independence		('ence')	c1,2	s22
intro 7	1-23	statement	slide/	suffix	c1	s23
Unit 20B	1-24	basement	flick	('ment')	c1	s24
	1-25	improvement			c1	s25
	1-26	department			c1	s26
	1-27	entertainment			c1	s27
	1-28	neighborhood		('hood')	c1	s28
rev2				review of ment		

(Appendix B - Continued)

section	label	word	a-v method	concept	counter	switch
intro 8	2-1	national	tape/	suffixes ('al)	c3,1	s1
Unit 21A	2-2	section	sentence	('tion')	c3	s2
	2-3	election			c3	s3
	2-4	attention			c3	s4
	2-5	union		('ion)	c4	s5
	2-6	decoration		('tion')	c3	s6
	2-7	constitution			c3	s7
	2-8	population			c3	s8
	2-9	championship		('ion', 'ship')	c4,1	s9

APPENDIX C

Basic List of Spelling Words in Order of Appearance

1. holy
2. easily
3. slippery
4. military
5. copy
6. windy
7. silly
8. tardy
9. daily
10. thirsty
11. tiny
12. empty
13. cherry
14. ugly
15. excitement
16. settlement
17. amusement
18. development
19. instrument
20. community
21. safety
22. independence
23. statement
24. basement
25. improvement
26. department
27. entertainment
28. neighborhood
29. national
30. section
31. election
32. attention
33. union
34. decoration
35. constitution
36. population
37. championship
38. onion
39. million
40. invitation
41. direction
42. dictionary
43. complete
44. remind
45. prepare
46. project
47. comfort
48. provide
49. congress
50. contain
51. remove
52. prevent
53. program
54. mistake
55. absent
56. subtract
57. in.
58. etc.
59. Dr.
60. lb.
61. per cent
62. ft.
63. girl's
64. girls'
65. boy's
66. boys'
67. babies'
68. baby's
69. men's
70. women's
71. children's
72. dining
73. wasting
74. teasing
75. including
76. greasing
77. securing
78. improving
79. shaking
80. weaving
81. slicing
82. tasting
83. squeezing
84. saluting
85. introducing
86. memories
87. ditches
88. ashes
89. navies
90. switches

(APPENDIX C - continued)

91. dairies
92. liberties
93. weeds
94. sleeves
95. roots
96. patches
97. peaches
98. groceries
99. boots
100. empire
101. signal
102. curtain
103. injure
104. advice
105. object
106. insects
107. costume
108. carpet
109. napkin
110. multiply
111. attic
112. fortune
113. button
114. extra
115. alley
116. tab..et
117. current
118. public
119. rotten
120. offer
121. commerce
122. member
123. pardon
124. expense
125. control
126. almost
127. timber
128. worship
129. sore
130. brake
131. forth
132. their's
133. peace
134. stake
135. principal
136. steal
137. pail
138. bare
139. pain
140. pour
141. dye
142. sense
143. weak
144. obey
145. event
146. promote
147. moment
148. cocoa
149. polite
150. climate
151. soda
152. behind
153. zero
154. awake
155. vacant
156. select
157. modern
158. agree
159. proper
160. idea
161. products
162. satisfy
163. various
164. attractive
165. metal
166. salad
167. nylon
168. pirate
169. violin
170. gasoline
171. between
172. lemonade
173. continent
174. disappoint
175. sincerely
176. carnival
177. necessary
178. museum
179. chocolate
180. magazine

(APPENDIX C - continued)

181. opera
182. envelope
183. tobacco
184. material
185. gymnasium
186. cafeteria
187. cough
188. style
189. double
190. beauty
191. journey
192. stomach
193. social
194. medicine
195. scissors
196. shoulder
197. shovel
198. honey
199. iron
200. apron
201. screw
202. lying
203. garage
204. pigeon
205. machine
206. measure
207. junior
208. manufacture
209. dangerous
210. soup
211. blind
212. court
213. figure
214. nature
215. hitch
216. acres

APPENDIX D_1

Samples of Taped Messages

Word No.	Tape No.	Word, Sentence, Word
1	5	holy We visited the holy temple holy
2	6	easily It is work that is easily done easily
3	7	slippery The wet rocks are slippery. slippery
4	8	military The general is a military man. military
5	9	copy You may copy the sentence. copy
6	10	windy Sometimes March is a windy month. windy
7	11	silly He is acting silly. silly
8	12	excitement The fire caused great excitement. excitement
9	13	settlement Boston was an early settlement. settlement
10	14	amusement We watched television for amusement. amusement

APPENDIX D_2

Samples of Slides

Slide for Remedial Branch on Forming Syllables

To Form Syllables,
Divide between the two Consonants

S i l v e r

Sil - ver

Slide for Extra I

FIND THE WORDS

e	d	i	e	t	u	t	e	f	f	e	c	t	t
o	y	t	c	e	x	e	r	c	i	s	e	s	s
v	i	e	w	t	j	l	g	i	n	n	e	r	y
a	c	o	m	m	i	t	t	e	e	y	o	j	g
m	t	s	e	r	i	e	s	p	o	c	c	u	r
e	m	e	n	t	z	q	m	e	a	n	t	u	d
b	u	o	d	o	r	e	j	f	c	i	v	i	c

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APPENDIX D_2

Sample of Slide with
Picture and Sentence

A b_____ is missing on the coat.

APPENDIX E_1

Sample of Pretest with Pa0 Function and Tape Message

Label	Op Code	Text	Explanation
1-15	rd		
	ld	0//c9	counter 9 cleared
1-15-r	tp1	12	tape message 12 played
	tp0	13	next tape positioned
	qu	15	numeral typed; student types response
	nx		
	fn	kw//1	
	ca	excitement Excitement EXCITEMENT	spellings searched for and accepted
	ty	Very Good!	typed when word is spelled correctly
	nx		
	fn	kw//1	
	wa	r	if student typed "r", branches back to repeat tape
	br	1-15r	
	nx		
	fn	kw//1	
	aa	#ment#	check to see if "ment" is misspelled
	br	1-15a	if "ment" not misspelled, branches on
	ad	1//c1	if "ment" is misspelled, information is stored for remedial branch on suffixes

Label	Op Code	Text	Explanation
1-15a	nx		
	ld	1//s15	store word misspelled for a "Help"
	ad	1//c8	store for total words misspelled
	br	ty15//c9//e//3	after 3 tries, branches to complete feedback
	fn	pa0//1t//0	
	wa	excitement	correct letters in student's answer are searched for and typed
	ad	1//c9	records number of student attempts
ty15	nx		
	fn	pa0//1r//0	
	wa	excitement	complete feedback with incorrect letters in red

APPENDIX E_2

Sample of Pretest with Pa0 Function and Picture-Slide

Label	Op Code	Text	Explanation
3-12	rd		
	ld	0//c9	
	fpl	46	slide 46 is displayed
	qu	83	
	nx		
	fn	kw//1	
	ca	squeezing Squeezing SQUEEZING	spellings searched for and accepted
	ty	Fine!	
	nx		
	fn	kw//1	
	aa	#eing#	check for use of "eing"
	ad	1//c5	if "eing" present, information is stored for remedial branch
	nx		
	br	3-12a	if "eing" not present, branches on
3-12a	nx		
	fn	kw//1	
	aa	#ee#	check to see if "ee" is present
	br	3-126	if "ee" is present, branches on
	nx		
	ad	1//c6	if "ee" is not present, store information for double vowel remedial branch

(APPENDIX E_2 - continued)

Label	Op Code	Text	Explanation
3-12b	nx		
	ld	1//s2	
	ad	1//c8	
	br	ty83//c9//e//3	
	fn	pa0//1t//0	
	wa	squeezing	
	ad	1//c9	
ty83	nx		
	fn	pa0//1r//0	
	wa	squeezing	

APPENDIX E_3

Sample of a Remedial Branch

Remedial 7 for Forming Plurals

Label	Op Code	Text	Explanation
Rem 7	rd		
	ty	To form the plural of a word, you need to know when to: 1. add s, 2. add es, 3. change y to i add es.	
	ty	The slide that you will see will help you form plurals correctly.	
	fpl	77	
	fn	wait//5	5 second wait for student to observe slide
	ty	Most plurals are formed by adding s.	
	ty	You add es when a word ends in s, sh, ch, or x.	
	ty	When you add es to a word, you will hear a new syllable. Say the word box to yourself. Now say the plural, boxes.	
	ty	Do you hear the new syllable?	
Rem 7a	rd		
	ty	When a word ends in a consonant-y, as in baby, you change the y to i and add es.	
	ty	baby -- babies	

(APPENDIX E_3 - continued)

Label	Op Code	Text	Explanation
Rem 7b	rd		
	ty	I will give you some words. See if you can type the plural form correctly.	
	qu	Type the plural of root.	
	nx		
	fn	kw//1	
	ca	roots	
	ty	Right. You add s.	
	ld	0//s24	eliminate root as a Help section.
	br	rem 7d	branch past rem 7c, the next question.
	un	The plural of root is roots. Try another one.	if incorrect response
	br	qul	
Rem 7c	rd		
	qu	Type the plural of hog.	

APPENDIX E_4

Sample of Extra 1

Label	Op Code	Text	Explanation
extra 1	rd		
	fpl	70	slide 7[illegible] with "extra 1" is displayed
	ty	On the screen you see seven rows of letters.	
	ty	In each row there are one or two hidden words.	
	ty	You will be given a clue to help you find each word.	
exl	qu	In row one, find and type the word that refers to food you eat.	
	nx		
	fn	kw//1	
	ca	diet Diet DIET	
	ty	Good	
	un	Find the four letter word that begins with d and ends with t.	typed after first incorrect response
	un	The word is "diet". Do you see it in the first row? Type diet.	typed after second incorrect response

(APPENDIX E_4 - continued)

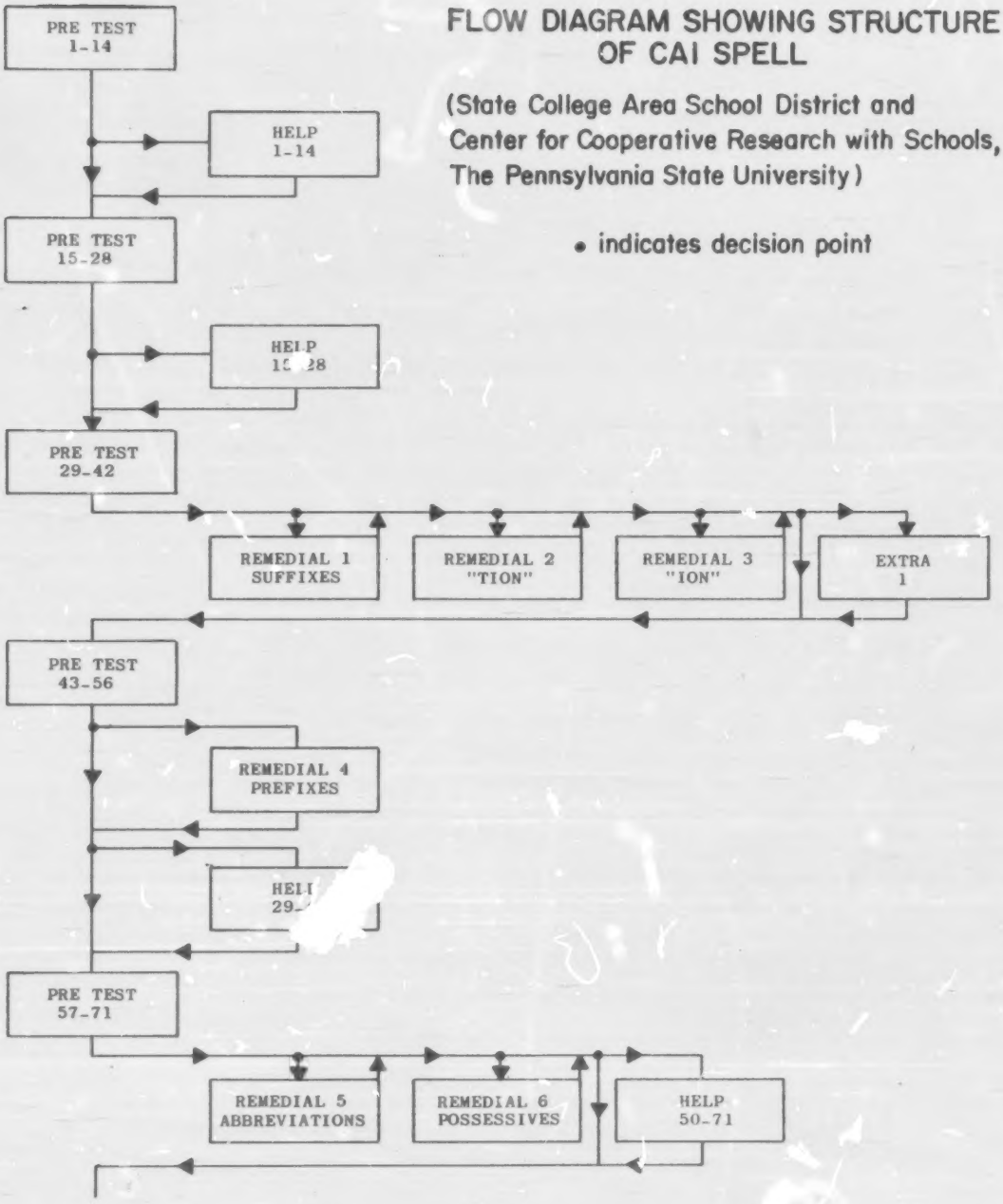
Label	Op Code	Text	Explanation
extra 2	qu	In row one, find and type the word that means the result or outcome.	
	nx		
	fn	kw//1	
	ca	effect Effect EFFECT	
	ty	That's right!	
	un	The word you are looking for is often misspelled "affect".	typed after first incorrect response
	un	The word is effect. Do you see it near the end of row one? Type effect.	typed after second incorrect response

APPENDIX F

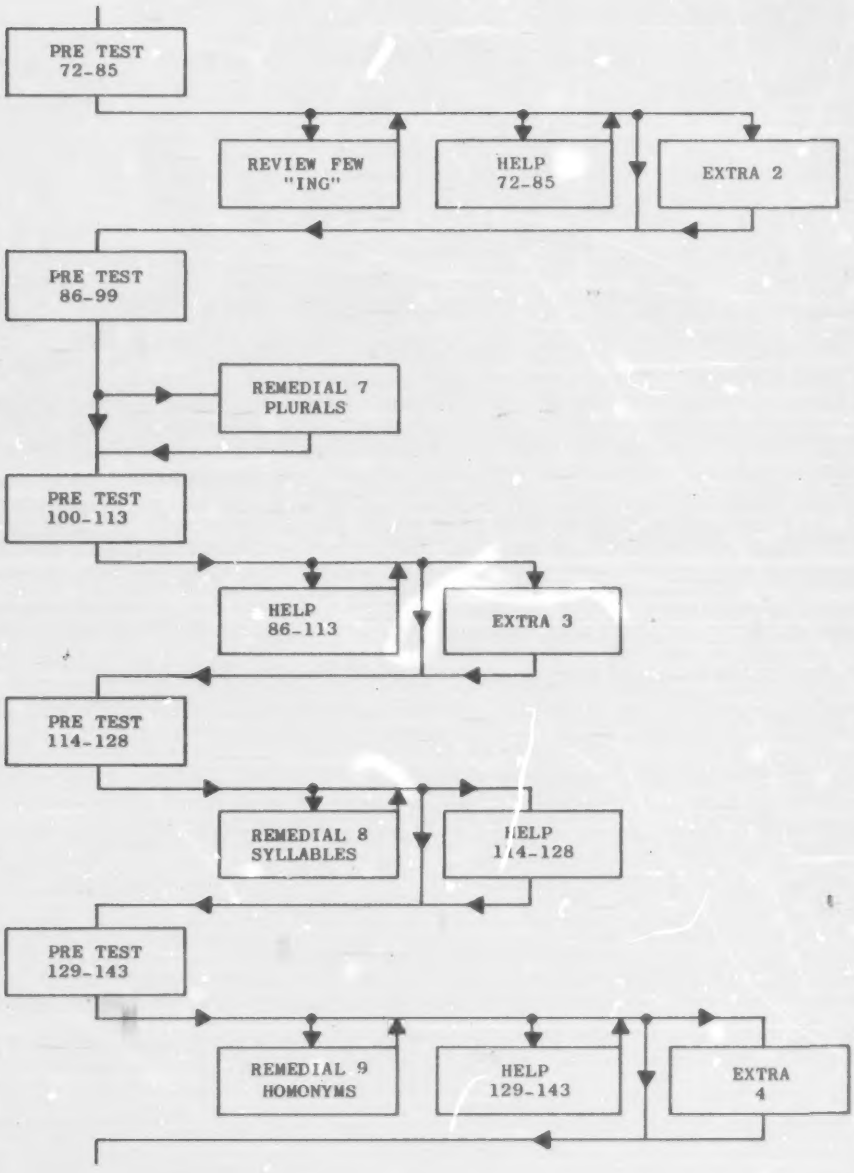
FLOW DIAGRAM SHOWING STRUCTURE OF CAI SPELL

(State College Area School District and Center for Cooperative Research with Schools, The Pennsylvania State University)

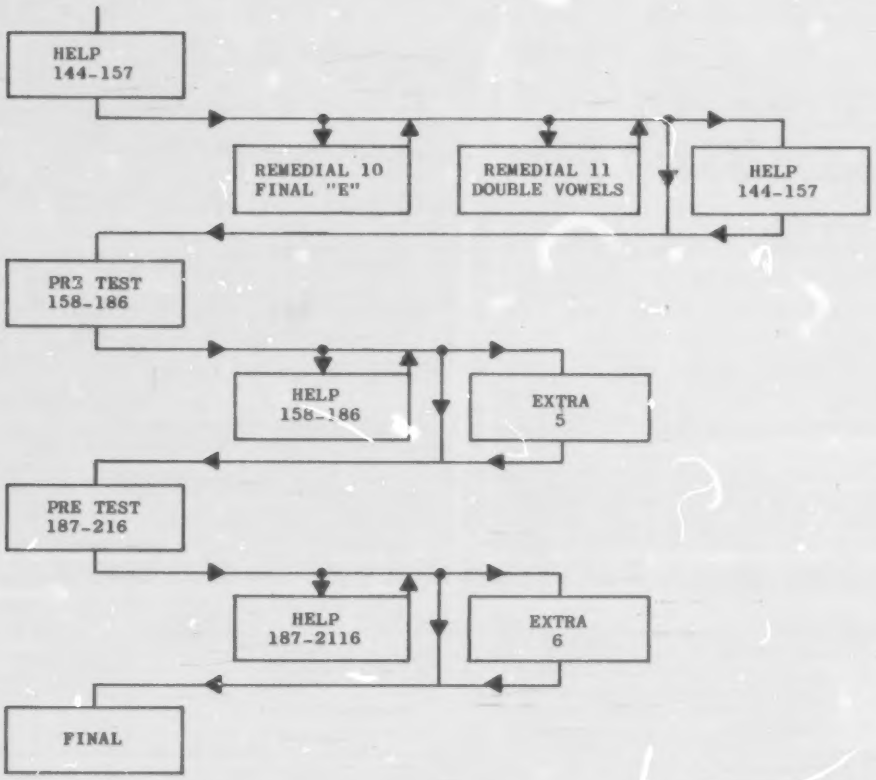
• indicates decision point



(APPENDIX F - continued)



(APPENDIX F - continued)



APPENDIX G

Dictated Spelling Words - Pretest and Posttest

Part I	(Words selected randomly from basic list)
1. reminded	His mother reminded him to clean the room.
2. worship	People worship in a church.
3. patches	He had patches on his pants.
4. slippery	The sidewalk was slippery with ice.
5. dye	She wanted to dye her sweater blue.
6. children's	The children's shoes were muddy.
7. include	Does your lunch include an apple?
8. garage	The car was put in the garage.
9. excitement	There was much excitement at Christmas.
10. constitution	A constitution tells how we are governed.
11. multiply	Multiply six times seven.
12. cocoa	We drink cocoa in the winter.
13. satisfy	He wants to satisfy his teacher.
14. gymnasium	They played basketball in the gymnasium.
15. scissors	We cut paper with scissors.

(APPENDIX G - continued)

Part II	(Words selected randomly from class observations)
1. plagued	She was plagued by doubts about her ability.
2. phenomenon	A ghost is a very unusual phenomenon.
3. conscientious	A doctor must be conscientious about his work.
4. exaggerated	The report of the battle was very exaggerated.
5. reprehensible	His behavior was reprehensible.
6. recommendation	The teacher's recommendation was that John should be sent home.
7. chronological	List events in chronological order.
8. saturation	The ground reached the saturation point.
9. miscellaneous	There are many miscellaneous articles in the grocery store.
10. hyphenated	The word was hyphenated.

APPENDIX H_1

Spelling Attitude Scale

Directions:

This is to find out how you feel about spelling. Mark your answer for each question on the answer sheet. Depending on how you feel, mark:

A -- strongly agree
B -- agree
D -- disagree
E -- strongly disagree

1. I like spelling because there are rules.
2. I have always liked spelling.
3. I would rather do any other school subject than do spelling.
4. Spelling is easy for me.
5. I like spelling but I like other subjects just as well.
6. Trying to spell correctly makes me nervous.
7. I don't feel sure of myself in spelling.
8. I don't like spelling because the rules don't work.
9. I feel good toward spelling.
10. My mind goes blank and I am unable to think clearly when spelling.
11. When I hear the word spelling, I have a feeling of dislike.
12. Spelling is fun.
13. Spelling makes me feel as though I'm lost in a jungle of letters and can't find my way out.
14. I am afraid of spelling.
15. I like spelling better than any other subject.
16. When I know the word, I enjoy spelling.
17. I can't see much value in knowing how to spell.
18. I dread spelling.
19. I feel spelling is an important subject.
20. Being accurate in spelling makes me feel satisfied.

APPENDIX H_2

CAI Attitude Scale

Directions:

This is to find out how you feel about CAI spelling. Mark your answer for each question on the answer sheet. Depending on how you feel, mark:

A -- strongly agree
B -- agree
D -- disagree
E -- strongly disagree

You will never mark C at all.

1. CAI makes it possible for me to learn spelling quickly.
2. I am satisfied with what I am learning in CAI spelling.
3. I guess at the answers to questions in CAI.
4. I feel I can work at my own speed on CAI.
5. I feel as if I had a teacher just for me on CAI.
6. I find myself just trying to get through the material in CAI, rather than trying to learn.
7. I feel quite nervous on CAI.
8. I feel that CAI is a waste of time.
9. I feel as if someone were talking with me on CAI.
10. The way the words are taught on CAI becomes boring.
11. I like being told when I am right on CAI.
12. I am more involved in using the machine than in learning the words.
13. I am afraid that I might not be learning the words on CAI.
14. My feeling toward spelling before I was on CAI was better than it is now.
15. CAI makes me feel like doing my best work in spelling.
16. I feel that no one really cares whether I learn or not on CAI.
17. I prefer CAI to regular instruction for spelling.

APPENDIX I

Numbers of Percentages of Responses To Parental Reaction Form (CAI Spelling Group)

Attitude Scale Item	Responses	Number	Per Cent
1. When my child was assigned to Computer Assisted Instruction for spelling, he was:	a) please.	83	95
	b) indifferent.	4	5
	c) unhappy.		
2. As the CAI Spelling program progressed, I feel my child:	a) liked it.	82	94
	b) was indifferent.	3	3
	c) disliked it.	2	2
3. After beginning the CAI program, my child's attitude school:	a) improved.	18	21
	b) remained the same	68	78
	c) regressed		
4. During the CAI program, I feel my child's attitude toward spelling:	a) improved	58	67
	b) remained the same	27	31
	c) regressed	2	2
5. For his spelling lessons, I feel my child would:	a) prefer CAI	71	82
	b) prefer classroom instruction	11	13
	c) be indifferent	3	4
6. Did your child show you the materials he received from the CAI typewriter terminal?	a) usually	71	82
	b) sometimes	15	17
	c) never	1	1

(Appendix I - Continued)

Attitude Scale Item	Responses	Number	Per Cent
7. Was he able to explain the typed material to your satisfaction?	a) yes	76	87
	b) mixed feelings	6	7
	c) no	3	3
8. Were you able to visit the school to see the typewriter terminals in operation?	a) yes	14	16
	b) no	73	84
9. When my child was assigned to CAI for spelling, I was:	a) pleased	74	86
	b) indifferent	10	12
	c) unhappy	2	2.3
10. I would like to see further experimentation with CAI carried on in our schools.	a) yes	75	86
	b) mixed feelings	11	13
	c) no		
Please check your relation to the child	a) mother	59	68
	b) father	20	23
	c) relative or guardian		
	d) both parents	8	9

APPENDIX J

Table 1

Results of Analysis of Variance on Standardized Achievement for School 1

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	3592.06	1796.03	75.46	$<.001$
Method (M)	1	10.37	10.37	<1.00	N.S.
A x M	2	16.78	8.39	<1.00	N.S.
Error	60	1428.01	23.80		
Within Ss					
Pre-Post (P)	1	18.19	18.19	2.98	N.S.
P x A	2	20.78	10.39	1.70	N.S.
P x M	1	5.52	5.52	<1.00	N.S.
P x A x M	2	5.62	2.81	<1.00	N.S.
Error	60	366.39	6.11		
Total	131	5463.72			

Table 2

Results of Analysis of Variance on Standardized Achievement for School 2

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	2525.25	1262.63	67.32	<.001
Method (M)	1	0.31	0.31	<1.00	N.S.
A x M	2	8.06	4.03	<1.00	N.S.
Error	78	1462.88	18.75		
Within Ss					
Pre-Post (P)	1	102.19	102.19	11.70	< .01
P x A	2	164.38	82.19	9.41	<.01
P x M	1	0.44	0.44	<1.00	N.S.
P x A x M	2	3.50	1.75	<1.00	N.S.
Error	78	681.00	8.73		
Total	167	4898.00			

Table 3

Results of Analysis of Variance on Standardized Achievement for School 3

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	778.20	389.10	23.80	$<.001$
Error	30	490.56	16.35		
Within Ss					
Pre-Post (P)	1	0.14	0.14	<1.00	N.S.
P x A	2	1.92	0.96	<1.00	N.S.
Error	30	121.45	4.05		
Total	65	1392.27			

Table 4

Results of Analysis of Variance on Total Achievement for School 1

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	12759.00	6379.50	113.19	<.001
Method (M)	1	36.06	36.06	<1.00	N.S.
A x M	2	11.25	5.62	<1.00	N.S.
Error	60	3381.63	56.36		
Within Ss					
Pre-Post (P)	1	383.56	383.56	56.35	<.001
P x A	2	34.56	17.28	2.54	N.S.
P x M	1	16.69	16.69	2.45	N.S.
P x A x M	2	17.31	8.66	1.27	N.S.
Error	60	408.38	6.81		
Total	131	17048.44			

Table 5

Results of Analysis of Variance on Total Achievement for School 2

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	12263.50	6131.75	142.88	$<.001$
Method (M)	1	0.56	0.56	<1.00	N.S.
A x M	2	58.50	29.25	<1.00	N.S.
Error	78	3347.31	42.91		
Within Ss					
Pre-Post (P)	1	995.81	995.81	88.83	$<.001$
P x A	2	216.75	108.38	9.67	$<.01$
P x M	1	0.13	0.13	<1.00	N.S.
P x A x M	2	7.62	3.81	<1.00	N.S.
Error	78	874.44	11.21		
Total	167	17764.50			

Table 6

Results of Analysis of Variance on Total Achievement for School 3

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	4163.69	2081.84	42.27	<.001
Error	30	1477.38	49.25		
Within Ss					
Pre-Post (P)	1	24.25	24.25	3.70	N.S.
P x A	2	0.875	0.44	<1.00	N.S.
Error	30	196.88	6.56		
Total	65	5863.06			

Table 7

Results of Analysis of Variance on Attitude Toward Spelling for School 1

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	3844.25	1922.13	21.60	$<.001$
Method (M)	1	500.38	500.38	5.62	$<.05$
A x M	2	158.13	79.06	<1.00	N.S.
Error	60	5339.19	88.99		
Within Ss					
Pre-Post (P)	1	26.38	26.38	1.51	N.S.
P x A	2	89.44	44.72	2.55	N.S.
P x M	1	54.63	54.63	3.12	N.S.
P x A x A	2	19.50	9.75	<1.00	N.S.
Error	60	1050.56	17.51		
Total	131	11082.44			

Table 8

Results of Analysis of Variance on Attitude Toward Spelling for School 2

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	2175.06	1087.53	10.29	$<.001$
Method (M)	1	29.88	29.88	<1.00	N.S.
A x M	2	210.19	105.09	<1.00	N.S.
Error	78	8240.25	105.64		
Within Ss					
Pre-Post (P)	1	78.63	78.63	6.48	$<.05$
P x A	2	87.00	43.50	3.59	$<.05$
P x M	1	15.63	15.63	1.29	N.S.
P x A x M	2	40.88	20.44	1.68	N.S.
Error	78	946.33	12.13		
Total	167	11823.88			

Table 9

Results of Analysis of Variance on Attitude
Toward Spelling for School 3

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	650.63	325.31	3.39	$<.05$
Error	30	2871.06	95.70		
Within Ss					
Pre-Post (P)	1	12.69	12.69	<1.00	N.S.
P x A	2	9.38	4.69	<1.00	N.S.
Error	30	659.44	21.98		
Total	65	4203.19			

Table 10

Results of Analysis of Variance on Attitude
Toward CAI for School 1

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability	2	353.44	176.72	4.12	$<.05$
Error	30	1286.00	42.87		
Within Ss					
Pre-Post (P)	1	7.31	7.31	<1.00	N.S.
P x A	2	56.13	28.06	3.24	N.S.
Error	30	259.56	8.65		
Total	65	3327.31			

Table 11

Results of Analysis of Variance on Attitude Toward CAI for School 2

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	875.81	437.91	8.85	<.001
Error	39	1930.50	49.50		
Within Ss					
Pre-Post (P)	1	13.75	13.75	1.11	N.S.
P x A	2	25.06	12.53	1.01	N.S.
Error	39	482.19	12.36		
Total	83	3327.31	40.09		

Table 12

Results of Analysis of Variance on Attitude Toward Spelling for School 3

Source	df	S.S.	M.S.	F	P
Between Ss					
Ability (A)	2	54.25	27.13	<1.00	N.S.
Error	30	1328.13	44.27		
Within Ss					
Pre-Post (P)	1	87.56	87.56	3.24	N.S.
P x A	2	43.00	21.50	<1.00	
Error	30	810.44	27.01		
Total	65				

APPENDIX K

Table 1

Mean Scores for Standardized Achievement - School 1

	Conventional			CAI		
Ability	N	Pretest	Posttest	N	Pretest	Posttest
High	11	25.55	25.82	11	25.46	25.46
Middle	11	20.55	20.27	11	21.55	22.27
Low	11	12.27	13.27	11	11.82	14.55

Table 2

Mean Scores for Standardized Achievement - School 2

	Conventional			CAI		
Ability	N	Pretest	Posttest	N	Pretest	Posttest
High	14	25.36	25.07	14	25.50	26.00
Middle	14	22.29	22.29	14	21.71	22.14
Low	14	14.00	18.64	14	13.86	17.93

Table 3

Mean Scores for Standardized Achievement - School 3

Ability	N	Pretest	Posttest
High	11	26.18	25.91
Middle	11	21.73	22.27
Low	11	17.64	17.64

Table 4

Mean Scores for Total Achievement - School 1

	Conventional			CAI		
Ability	N	Pretest	Posttest	N	Pretest	Posttest
High	11	38.55	40.73	11	39.64	41.45
Middle	11	27.09	30.18	11	28.18	32.73
Low	11	14.46	17.27	11	13.27	19.27

Table 5

Mean Scores for Total Achievement - School 2

	Conventional			CAI		
Ability	N	Pretest	Posttest	N	Pretest	Posttest
High	14	39.71	41.79	14	40.57	43.64
Middle	14	31.00	35.14	14	30.93	34.93
Low	14	17.14	25.64	14	16.14	23.57

Table 6

Mean Scores for Total Achievement - School 3

Ability	N	Pretest	Posttest
High	11	43.36	44.64
Middle	11	33.36	34.82
Low	11	24.09	25.00

Table 7

Mean Scores for Attitude Toward Spelling - School 1

	Conventional			CAI		
Ability	N	Pretest	Posttest	N	Pretest	Posttest
High	11	62.91	62.55	11	66.64	66.73
Middle	11	63.09	61.73	11	62.27	64.91
Low	11	51.64	46.82	11	56.55	55.00

Table 8

Mean Scores for Attitude Toward Spelling - School 2

	Conventional			CAI		
Ability	N	Pretest	Posttest	N	Pretest	Posttest
High	14	65.71	63.79	14	68.29	69.21
Middle	14	61.29	65.07	14	61.14	63.36
Low	14	58.00	58.43	14	56.29	59.07

Table 9

Mean Scores for Attitude Toward Spelling - School 3

Ability	N	Pretest	Posttest
High	11	65.18	65.00
Middle	11	62.09	63.55
Low	11	56.91	58.27

Table 10

Mean Scores for Attitude Toward CAI - School 1

Ability	N	Pretest	Posttest
High	11	56.82	57.55
Middle	11	56.91	57.46
Low	11	53.91	50.64

Table 11

Mean Scores for Attitude Toward CAI - School 2

Ability	N	Pretest	Posttest
High	14	59.50	60.21
Middle	14	56.36	54.57
Low	14	52.64	51.29

Table 12

Mean Scores for Attitude Toward CAI - School 3

Ability	N	Pretest	Posttest
High	11	58.36	55.46
Middle	11	57.09	53.18
Low	11	54.91	54.82

APPENDIX L

Correlational Tables

The following tables of correlation matrices involve a numbering scheme for identifying the variables being correlated. Listed below are the numbers and the variables to which they refer:

Number	Variable
1	Total Achievement (Pretest)
2	Total Achievement (Posttest)
3	Attitude Toward Spelling (Pretest)
4	Attitude Toward Spelling (Posttest)
5	Attitude Toward CAI (Pretest)
6	Attitude Toward CAI (Posttest)
7	PaO - Relative Per cent Correct
8	PaO - Average Word Difficulty

Table 1

Correlation Matrix for School 1
Conventional and CAI Groups Combined (N = 66)

	1	2	3
2	.95		
3	.63	.62	
4	.59	.61	.80

$.01^{r}$ 60 = .33

Table 2

Correlation Matrix for School 2
Conventional and CAI Groups Combined (N = 84)

	1	2	3
2	.88		
3	.50	.60	
4	.45	.57	.82

$.01^{r}$ 80 = .28

Table 3

Correlation Matrix for School 1

CAI Group Only (N = 33)

	1	2	3	4	5	6	7
2	.96						
3	.68	.64					
4	.61	.59	.84				
5	.40	.43	.29	.49			
6	.61	.61	.40	.57	.71		
7	.93	.96	.62	.58	.42	.59	
8	-.90	-.93	-.62	-.57	-.40	-.64	-.96

$.01^{r}$ 30 = .45

Table 4

Correlation Matrix for School 2

CAI Group Only (N = 42)

	1	2	3	4	5	6	7
2	.91						
3	.52	.53					
4	.49	.55	.86				
5	.49	.46	.25	.23			
6	.58	.55	.34	.39	.70		
7	.90	.93	.54	.55	.48	.55	
8	-.84	-.90	-.49	-.51	-.45	-.53	-.97

$.01^{r}$ 40 = .39

Table 5

Correlation Matrix for School 3

CAI Group (N = 33)

	1	2	3	4	5	6	7
2	.93						
3	.51	.51					
4	.38	.37	.68				
5	.40	.34	.40	.48			
6	.06	.13	.41	.55	.24		
7	.86	.91	.53	.43	.39	.20	
8	-.76	-.84	-.49	-.41	-.37	-.21	-.96

$.05^{r}\ 30 = .45$

APPENDIX M

Average Amount of Program Completed*

Ability Level	Number of Words and Percent of Program				
	Finished Program	215 to 173 words (80 to 90%)	172 to 130 words (60 to 79%)	129 to 108 words (50 to 59%)	107 words or less (less than 50%)
High:					
Number	25				
Percent	100				
Middle:					
Number	21	3	1		
Percent	84	12	4		
Low:					
Number	4	3	10	3	5
Percent	16	12	40	12	20
Total:					
Number	50	6	11	3	5
Percent	67	8	15	4	7

* Our Lady of Victory students are not included

APPENDIX N

Examples and Frequencies of Common Misspellings

Word	Frequency	Word	Frequency
easly	17	comerce	13
slipery	20	break (brake)	15
milatary	16	pore (pour)	16
emty	22	coco	23
excitment	34	nilon	17
amusment	18	disapoint	29
safty	36	dissapoint	19
atention	29	sincerly	23
invatation	18	magizine	14
compleat	14	envolope	13
comfert	15	cafateria	19
ect.	31	cafiteria	10
dinning	31	stile	15
daries	33	sissors	14
atic	20	pigon	11

APPENDIX O

Examples of Difficulty of Words

Word	Percentage of Times Correctly Spelled	Method used to introduce word
mistake	96%	Slide-flick
contain	90%	Slide- flick
windy	86%	Tape
project	80%	Tape
population	75%	Tape
onion	71%	Slide-picture
women's	66%	Slide-sentence
dictionary	60%	Slide-picture
direction	55%	Slide-picture
easily	51%	Tape
military	45%	Tape
men's	41%	Slide-picture
etc.	34%	Slide-sentence
sleeves	30%	Slide-picture
chocolate	25%	Tape
cafeteria	19%	Slide-sentence
necessary	12%	Tape
disappoint	6%	Tape

APPENDIX P_1

Number and Percentages of Students
Branched into Remedial Sections*

Group Totals	Remedial Sections											
	1	2	3	4	5	6	Review Few	7	8	9	10	11
High:												
Number	2	3	1	2	8	28	1	10	10	14	1	7
Percent	2	3	.9	2	7	26	.9	9	9	13	.9	6
Middle:												
Number	8	19	11	4	18	33	2	17	26	22	10	13
Percent	7	17	10	3	17	30	2	16	24	20	9	12
Low:												
Number	27	31	30	21	32	34	18	33	29	19	11	12
Percent	25	28	28	20	29	31	17	30	27	17	10	11
Total:												
Number	37	53	42	27	58	[illegible]	21	60	65	55	22	32
Percent	34	49	39	25	53	87	19	55	60	51	20	29

* Includes Our Lady of Victory students

APPENDIX P_2

Number and Percentages of Students
Branched into Extras*

Group Totals	Extra Sections					
	1. Find the Words	2. Proofread	3. Proper Nouns	4. Homonyms	5. Find the Words	6. Proofread
High:						
Number	36	36	16	22	14	15
Percent	33	33	15	20	13	14
Middle:						
Number	25	32	1	8	1	1
Percent	23	29	.9	7	.9	.9
Low:						
Number	5	16		1		
Percent	5	15		.9		
Total:						
Number	66	84	17	31	15	16
Percent	61	77	16	29	14	15

* Includes Our Lady of Victory students